

THAT WHICH IS CLAIMED IS:

1 1. In a short-range wireless networking environment, a method
2 of enabling communication between at least one end device and at
3 least one application server, comprising the steps of:

4 providing at least one access point (AP), wherein each of
5 the APs has at least one short-range wireless connection and at
6 least one network connection;

7 providing at least one extension point (EP), wherein:

8 each of the EPs has at least two short-range wireless
9 connections;

10 at least one of the EPs communicates with at least one
11 of the APs; and

12 at least one of the EPs communicates with at least one
13 of the end devices; and

14 transmitting traffic between a selected one of the
15 application servers and a selected one of the end devices,
16 wherein the transmitted traffic flows through a selected one of
17 the APs and at least one of the EPs.

1 2. The method according to Claim 1, wherein a short-range
2 wireless link established through at least one of the two short-
3 range wireless connections uses a protocol known as "Bluetooth".

1 3. The method according to Claim 1, wherein one of the at
2 least two short-range wireless connections uses a directional
3 antenna.

1 4. The method according to Claim 3, wherein the directional
2 antenna is used to communicate with a selected one of the APs.

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1 5. The method according to Claim 3, wherein the directional
2 antenna is used to communicate with another EP.

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1 6. The method according to Claim 1, wherein one of the at
2 least two short-range wireless connections
3 uses an omnidirectional antenna.

1 7. The method according to Claim 6, wherein the
2 omnidirectional antenna is used to communicate with a selected
3 one of the end devices.

1 8. The method according to Claim 6, wherein the
2 omnidirectional antenna is used to communicate with another EP.

1 9. The method according to Claim 1, wherein each EP is powered
2 using a photovoltaic array or photovoltaic module.

1 10. The method according to Claim 1, wherein each EP comprises
2 an antenna controller, an amplifier, a power supply, and a
3 short-range communication function.

1 11. The method according to Claim 10, wherein the short-range
2 communication function is a Bluetooth module.

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1 12. The method according to Claim 1, wherein each EP comprises
2 an antenna controller, an amplifier, a power supply, and a
3 short-range radio frequency communication module.

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1 13. The method according to Claim 12, wherein the short-range
2 radio frequency communication module is a Bluetooth module.

1 14. The method according to Claim 1, wherein the at least one
2 EP communicating with the at least one AP and the at least one
3 EP communicating with the at least one end device are the same
4 EP.

1 15. The method according to Claim 1, further comprising the
2 step of providing a connection table which maintains a plurality
3 of EP parameter blocks.

1 16. The method according to Claim 15, wherein the connection
2 table is provided at a network control server.

1 17. The method according to Claim 15, further comprising the
2 step of using the EP parameter blocks to describe a route
3 between a selected EP and a selected AP.

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1 18. The method according to Claim 1, wherein a short-range
2 wireless link established through at least one of the two short-
3 range wireless connections uses an omnidirectional antenna at a
4 first endpoint of the wireless link and a directional antenna at
5 a second endpoint of the wireless link.

1 19. The method according to Claim 18, wherein a position of the
2 directional antenna is set to minimize a bit error rate along
3 the wireless link.

1 20. The method according to Claim 19, further comprising the
2 step of dynamically determining the position of the directional
3 antenna, further comprising the steps of:

4 positioning the directional antenna at a plurality of
5 angles toward the omnidirectional antenna;

6 recording the bit error rate at each of the angles; and

7 selecting that one of the angles which exhibits a minimal
8 value of the bit error rate to be the position of the
9 directional antenna.

1 21. The method according to Claim 20, wherein the plurality of
2 angles are selected by first locating an initial position beyond
3 which communication using the directional antenna is not
4 possible.

1 22. The method according to Claim 18, wherein a power of
2 transmission of the directional antenna is set to a minimum
3 value required to communicate on the wireless link.

1 23. The method according to Claim 22, further comprising the
2 step of dynamically determining the power of transmission of the
3 directional antenna, further comprising the steps of:

4 establishing a default value for the power of transmission;
5 recording a bit error rate at the default value;
6 successively reducing the power of transmission until
7 connectivity is lost or the bit error rate crosses a threshold;
8 and

9 setting the power of transmission to be a value that
10 results in the bit error rate staying below the threshold.

1 24. The method according to Claim 23, wherein the threshold is
2 a maximum acceptable value for the bit error rate.

Sub tag 25. A method for dynamically tuning a directional antenna of a
2 wireless device [it would be nice for "device" here to cover
3 both end-user devices and EPs (e.g. cover EPs here to cover the
4 tuning procedure without the baggage of claim 1). Is there a
5 better word, or may be should say "device or EP"] for
6 communicating with an access point in a short-range wireless
7 networking environment, comprising the steps of:

8 providing at least one wireless device;

9 providing at least one access point;

10 establishing a network link between a selected one of the
11 wireless devices and a selected one of the access points using
12 the directional antenna of the selected wireless device and an
13 omnidirectional antenna of the selected access point; and

14 setting a position of the directional antenna to minimize a
15 bit error rate along the established link.

1 26. The method according to Claim 25, wherein the step of
2 setting the position of the directional antenna further
3 comprises the steps of:

4 positioning the directional antenna at a plurality of
5 angles toward the omnidirectional antenna;
6 recording the bit error rate at each of the angles; and
7 selecting one of the angles which exhibits a minimal value
8 of the bit error rate to be the position of the directional
9 antenna.

1 27. The method according to Claim 26, wherein the plurality of
2 angles are selected by first locating an initial position beyond
3 which communication using the directional antenna is not
4 possible.

1 28. The method according to Claim 25, further comprising the
2 step of setting a power of transmission of the directional
3 antenna to a minimum value required to communicate on the
4 established link.

1 29. The method according to Claim 28, wherein the step of
2 setting the power of transmission of the directional antenna
3 further comprises the steps of:

4 setting the power of transmission to a default value;
5 recording a bit error rate at the default value;

6 successively reducing the power of transmission until
7 connectivity is lost or the bit error rate crosses a threshold;
8 and

9 setting the power of transmission to be a value that
10 results in the bit error rate staying below the threshold.

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1 30. The method according to Claim 29, wherein the threshold is
2 a maximum acceptable value for the bit error rate.

1 31. The method according to Claim 25, wherein the selected
2 wireless device is an extension point device.

1 32. The method according to Claim 25, wherein the selected
2 wireless device is an end-user device.

1 33. Computer program instructions embodied on one or more
2 computer-readable media, the computer program instructions
3 adapted for enabling communication between at least one end
4 device and at least one application server in a short-range
5 wireless networking environment and comprising:

6 computer program instructions for communicating with at
7 least one access point (AP), wherein each of the APs has at
8 least one short-range wireless connection and at least one
9 network connection;

10 computer program instructions for communicating with at
11 least one extension point (EP), wherein:
12 each of the EPs has at least two short-range wireless
13 connections;
14 at least one of the EPs communicates with at least one
15 of the APs; and
16 at least one of the EPs communicates with at least one
17 of the end devices; and
18 computer program instructions for transmitting traffic
19 between a selected one of the application servers and a selected
20 one of the end devices, wherein the transmitted traffic flows
21 through a selected one of the APs and at least one of the EPs.

1 34. The computer program instructions according to Claim 33,
2 wherein a short-range wireless link established through at least
3 one of the two short-range wireless connections uses a protocol
4 known as "Bluetooth".

1 35. The computer program instructions according to Claim 33,
2 wherein one of the at least two short-range wireless connections
3 uses a directional antenna.

1 36. The computer program instructions according to Claim 35,
2 wherein the directional antenna is used to communicate with a
3 selected one of the APs.

1 37. The computer program instructions according to Claim 35,
2 wherein the directional antenna is used to communicate with
3 another EP.

1 38. The computer program instructions according to Claim 33,
2 wherein one of the at least two short-range wireless connections
3 uses an omnidirectional antenna.

1 39. The computer program instructions according to Claim 38,
2 wherein the omnidirectional antenna is used to communicate with
3 a selected one of the end devices.

1 40. The computer program instructions according to Claim 38,
2 wherein the omnidirectional antenna is used to communicate with
3 another EP.

1 41. The computer program instructions according to Claim 33,
2 wherein each EP is powered using a photovoltaic array or
3 photovoltaic module.

1 42. The computer program instructions according to Claim 33,
2 wherein each EP comprises an antenna controller, an amplifier, a
3 power supply, and a short-range communication function.

1 43. The computer program instructions according to Claim 42,
2 wherein the short-range communication function is a Bluetooth
3 module.

1 44. The computer program instructions according to Claim 33,
2 wherein each EP comprises an antenna controller, an amplifier, a
3 power supply, and a short-range radio frequency communication
4 module.

1 45. The computer program instructions according to Claim 44,
2 wherein the short-range radio frequency communication module is
3 a Bluetooth module.

1 46. The computer program instructions according to Claim 33,
2 wherein the at least one EP communicating with the at least one
3 AP and the at least one EP communicating with the at least one
4 end device are the same EP.

1 47. The computer program instructions according to Claim 33,
2 further comprising computer program instructions for providing a
3 connection table which maintains a plurality of EP parameter
4 blocks.

1 48. The computer program instructions according to Claim 47,
2 wherein the connection table is provided at a network control
3 server.

1 49. The computer program instructions according to Claim 47,
2 further comprising computer program instructions for using the
3 EP parameter blocks to describe a route between a selected EP
4 and a selected AP.

1 50. The computer program instructions according to Claim 33,
2 wherein a short-range wireless link established through at least
3 one of the two short-range wireless connections uses an
4 omnidirectional antenna at a first endpoint of the wireless link
5 and a directional antenna at a second endpoint of the wireless
6 link.

1 51. The computer program instructions according to Claim 50,
2 wherein a position of the directional antenna is set to minimize
3 a bit error rate along the wireless link.

1 52. The computer program instructions according to Claim 51,
2 further comprising computer program instructions for dynamically
3 determining the position of the directional antenna, further
4 comprising:

5 computer program instructions for positioning the
6 directional antenna at a plurality of angles toward the
7 omnidirectional antenna;

8 computer program instructions for recording the bit error
9 rate at each of the angles; and

10 computer program instructions for selecting that one of the
11 angles which exhibits a minimal value of the bit error rate to
12 be the position of the directional antenna.

1 53. The computer program instructions according to Claim 52,
2 wherein the plurality of angles are selected by first locating
3 an initial position beyond which communication using the
4 directional antenna is not possible.

1 54. The computer program instructions according to Claim 50,
2 wherein a power of transmission of the directional antenna is
3 set to a minimum value required to communicate on the wireless
4 link.

1 55. The computer program instructions according to Claim 54,
2 further comprising computer program instructions for dynamically
3 determining the power of transmission of the directional
4 antenna, further comprising:

5 computer program instructions for establishing a default
6 value for the power of transmission;

7 computer program instructions for recording a bit error
8 rate at the default value;

9 computer program instructions for successively reducing the
10 power of transmission until the bit error rate crosses a
11 threshold; and

12 computer program instructions for setting the power of
13 transmission to be a value that results in the bit error rate
14 staying below the threshold.

1 56. The computer program instructions according to Claim 55,
2 wherein the threshold is a maximum acceptable value for the bit
3 error rate.

1 57. Computer program instructions for dynamically tuning a
2 directional antenna of a wireless device for communicating with
3 an access point in a short-range wireless networking
4 environment, the computer program instructions embodied on one
5 or more computer readable media and comprising:

6 computer program instructions for communicating with at
7 least one wireless device;

8 computer program instructions for communicating with at
9 least one access point;

10 computer program instructions for establishing a network
11 link between a selected one of the wireless devices and a
12 selected one of the access points using the directional antenna
13 of the selected wireless device and an omnidirectional antenna
14 of the selected access point; and

15 computer program instructions for setting a position of the
16 directional antenna to minimize a bit error rate along the
17 established link.

1 58. The computer program instructions according to Claim 57,
2 wherein the computer program instructions for setting the
3 position of the directional antenna further comprise:

4 computer program instructions for positioning the
5 directional antenna at a plurality of angles toward the
6 omnidirectional antenna;

7 computer program instructions for recording the bit error
8 rate at each of the angles; and

9 computer program instructions for selecting one of the
10 angles which exhibits a minimal value of the bit error rate to
11 be the position of the directional antenna.

1 59. The computer program instructions according to Claim 58,
2 wherein the plurality of angles are selected by first locating
3 an initial position beyond which communication using the
4 directional antenna is not possible.

1 60. The computer program instructions according to Claim 57,
2 further comprising computer program instructions for setting a
3 power of transmission of the directional antenna to a minimum
4 value required to communicate on the established link.

1 61. The computer program instructions according to Claim 60,
2 wherein the computer program instructions for setting the power
3 of transmission of the directional antenna further comprise:

4 computer program instructions for setting the power of
5 transmission to a default value;

6 computer program instructions for recording a bit error
7 rate at the default value;

8 computer program instructions for successively reducing the
9 power of transmission until the bit error rate crosses a
10 threshold; and

11 computer program instructions for setting the power of
12 transmission to be a value that results in the bit error rate
13 staying below the threshold.

1 62. The computer program instructions according to Claim 61,
2 wherein the threshold is a maximum acceptable value for the bit
3 error rate.

1 63. The computer program instructions according to Claim 57,
2 wherein the selected wireless device is an end device.

1 64. A system for enabling communication between at least one
2 end device and at least one application server in a short-range
3 wireless networking environment, comprising:

4 at least one access point (AP), wherein each of the APs has
5 at least one short-range wireless connection and at least one
6 network connection;

7 at least one extension point (EP), wherein each of the EPs
8 has at least two short-range wireless connections;

9 means for establishing communication between at least one
10 of the EPs and at least one of the APs; and

11 means for establishing communication between at least one
12 of the EPs and at least one of the end devices; and

13 means for transmitting traffic between a selected one of
14 the application servers and a selected one of the end devices,
15 wherein the transmitted traffic flows through a selected one of
16 the APs and at least one of the EPs.

1 65. The system according to Claim 64, wherein:

2 a short-range wireless link established through at least
3 one of the two short-range wireless connections uses a protocol
4 known as "Bluetooth";

5 one of the at least two short-range wireless connections
6 uses a directional antenna; and

7 one of the at least two short-range wireless connections
8 uses an omnidirectional antenna.

1 66. The system according to Claim 65, wherein the directional
2 antenna is used to communicate with a selected one of the APs.

1 67. The system according to Claim 65, wherein the
2 omnidirectional antenna is used to communicate with one or more
3 of: (1) a selected one of the end devices and (2) another EP.

1 68. The system according to Claim 64, wherein each EP comprises
2 an antenna controller, an amplifier, a power supply, and a
3 short-range communication function.

1 69. The system according to Claim 68, wherein the short-range
2 communication function is a Bluetooth module.

1 70. The system according to Claim 64, wherein the at least one
2 EP communicating with the at least one AP and the at least one
3 EP communicating with the at least one end device are the same
4 EP.

1 71. The system according to Claim 64, further comprising means
2 for providing a connection table which maintains a plurality of
3 EP parameter blocks.

1 72. The system according to Claim 71, wherein the connection
2 table is provided at a network control server.

1 73. The system according to Claim 71, further comprising means
2 for using the EP parameter blocks to describe a route between a
3 selected EP and a selected AP.

1 74. The system according to Claim 64, wherein a short-range
2 wireless link established through at least one of the two short-
3 range wireless connections uses an omnidirectional antenna at a
4 first endpoint of the wireless link and a directional antenna at
5 a second endpoint of the wireless link.

1 75. The system according to Claim 74, wherein a position of the
2 directional antenna is set to minimize a bit error rate along
3 the wireless link, and further comprising means for dynamically
4 determining the position of the directional antenna, further
5 comprising:

6 means for positioning the directional antenna at a
7 plurality of angles toward the omnidirectional antenna;

8 means for recording the bit error rate at each of the
9 angles; and

10 means for selecting that one of the angles which exhibits a
11 minimal value of the bit error rate to be the position of the
12 directional antenna.

1 76. The system according to Claim 75, wherein:

2 the plurality of angles are selected by first locating an
3 initial position beyond which communication using the
4 directional antenna is not possible; and

5 a power of transmission of the directional antenna is set
6 to a minimum value required to communicate on the wireless link;
7 and

8 further comprising means for dynamically determining the
9 power of transmission of the directional antenna, further
10 comprising:

11 means for establishing a default value for the power
12 of transmission;

13 means for recording a bit error rate at the default
14 value;

15 means for successively reducing the power of
16 transmission until the bit error rate crosses a threshold; and

17 means for setting the power of transmission to be a
18 value that results in the bit error rate staying below the
19 threshold.

1 77. A system for dynamically tuning a directional antenna of a
2 wireless device for communicating with an access point in a
3 short-range wireless networking environment, comprising:

4 at least one wireless device;

5 at least one access point;

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a2 means for establishing a network link between a selected
7 one of the wireless devices and a selected one of the access
8 points using the directional antenna of the selected wireless
9 device and an omnidirectional antenna of the selected access
10 point; and

11 means for setting a position of the directional antenna to
12 minimize a bit error rate along the established link.

1 78. The system according to Claim 77, wherein the means for
2 setting the position of the directional antenna further
3 comprises:

4 means for positioning the directional antenna at a
5 plurality of angles toward the omnidirectional antenna;

6 means for recording the bit error rate at each of the
7 angles; and

8 means for selecting one of the angles which exhibits a
9 minimal value of the bit error rate to be the position of the
10 directional antenna.

1 79. The system according to Claim 78, wherein the plurality of
2 angles are selected by first locating an initial position beyond
3 which communication using the directional antenna is not
4 possible.

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1 80. The system according to Claim 77, further comprising means
2 for setting a power of transmission of the directional antenna
3 to a minimum value required to communicate on the established
4 link, further comprising:

5 means for setting the power of transmission to a default
6 value;

7 means for recording a bit error rate at the default value;

8 means for successively reducing the power of transmission
9 until the bit error rate crosses a threshold; and

10 means for setting the power of transmission to be a value
11 that results in the bit error rate staying below the threshold.

1 81. The system according to Claim 80, wherein the threshold is
2 a maximum acceptable value for the bit error rate.

1 82. An extension point (EP) device for enabling communication
2 between at least one of a plurality of end devices and at least

3 one application server in a short-range wireless networking
4 environment, comprising:

5 means for establishing at least two short-range wireless
6 connections from the EP;

7 means for communicating, from the EP, with at least one
8 access point (AP), wherein each of the APs has at least one
9 short-range wireless connection and at least one network
10 connection;

11 means for communicating, from the EP, with at least one of
12 the end devices; and

13 means for transmitting traffic between the application
14 server and the at least one end device, wherein the transmitted
15 traffic flows through a selected one of the APs and the EP.

1 83. The device according to Claim 82, wherein:

2 a short-range wireless link established through at least
3 one of the two short-range wireless connections uses a protocol
4 known as "Bluetooth";

5 one of the at least two short-range wireless connections
6 uses a directional antenna; and

7 one of the at least two short-range wireless connections
8 uses an omnidirectional antenna.

1 84. The device according to Claim 83, wherein the directional
2 antenna is used to communicate with a selected one of the APs.

1 85. The device according to Claim 83, wherein the
2 omnidirectional antenna is used to communicate with one or more
3 of: (1) a selected one of the end devices and (2) another EP.

1 86. The device according to Claim 82, wherein each EP comprises
2 an antenna controller, an amplifier, a power supply, and a
3 short-range communication function.

1 87. The device according to Claim 86, wherein the short-range
2 communication function is a Bluetooth module.

1 88. The device according to Claim 82, wherein the at least one
2 EP communicating with the at least one AP and the at least one
3 EP communicating with the at least one end device are the same
4 EP.

1 89. The device according to Claim 82, wherein a short-range
2 wireless link established through at least one of the two short-
3 range wireless connections uses an omnidirectional antenna at a

4 first endpoint of the wireless link and a directional antenna at
5 a second endpoint of the wireless link.

1 90. The device according to Claim 89, wherein a position of the
2 directional antenna is set to minimize a bit error rate along
3 the wireless link, and further comprising means for dynamically
4 determining the position of the directional antenna, further
5 comprising:

6 means for positioning the directional antenna at a
7 plurality of angles toward the omnidirectional antenna;

8 means for recording the bit error rate at each of the
9 angles; and

10 means for selecting that one of the angles which exhibits a
11 minimal value of the bit error rate to be the position of the
12 directional antenna.

1 91. The device according to Claim 90, wherein:

2 the plurality of angles are selected by first locating an
3 initial position beyond which communication using the
4 directional antenna is not possible; and

5 a power of transmission of the directional antenna is set
6 to a minimum value required to communicate on the wireless link;
7 and

8 further comprising means for dynamically determining the
9 power of transmission of the directional antenna, further
10 comprising:
11 means for establishing a default value for the power
12 of transmission;
13 *Sub* means for recording a bit error rate at the default
14 *as* value;
15 means for successively reducing the power of
16 transmission until the bit error rate crosses a threshold; and
17 means for setting the power of transmission to be a
18 value that results in the bit error rate staying below the
19 threshold.

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